

3.10 Benchmarks of Measured Emission Rates Based on the NONROAD Model

This section describes benchmarking the PEMS data based on comparisons to emission factors that were estimated using the NONROAD model. Pollutants included NO_x, HC, CO, and PM. These emission factors are used for comparison purposes in order to obtain insight regarding validity of the field data. The expectation is that the field data and the nonroad data should be similar in magnitude. Because the NONROAD model is based on fleet average emission rates and on engine dynamometer measurements that have to be converted using an assumed brake-specific fuel consumption rate, it is not expected to have an exact agreement with the field data. The EPA's NONROAD model utilizes the unit of grams per brake horsepower hour instead of grams per unit of time. Using brake specific fuel consumption (BSFC) factors from the EPA's NONROAD model, units of grams per brake horsepower hour were converted into units of grams per gallon of fuel in order to enable comparisons with the PEMS data (EPA, 2004).

Table 28 shows the emission factors estimated from the NONROAD model that are for the same vehicle types, model years and engine horsepower as the tested vehicles in NCDOT's inventory.

For backhoes, the estimated NO emission rates based on the model decrease significantly for higher tiers by 33 percent from Tier 0 to Tier 2. The PM, HC, and CO emission rates also decrease substantially with respect to engine tier. Approximately, 75%, 65%, and 38% decreases for the estimated emission rates of PM, HC, and CO were observed for Tier 2 vs. Tier 0 respectively.

For front-end loaders, the estimated NO emission rates are similar for the three Tier 1 vehicles, but are lower for the higher tier vehicle. For PM, the emission rates are significantly lower for the Tier 2 engine versus the Tier 1 engines. For HC and CO, there is little variation in emission rates between tiers. On average, the differences are in the range of 1.4% to 60 %, depending on the pollutant.

The estimated NO emission rates for motor graders decrease significantly compared to those for backhoes and front-end loaders. For example, the Tier 3 vehicle has emission rates of NO approximately 72% lower than the Tier 0 vehicles. For PM, HC, and CO, the emission rates decrease monotonically as the tiers increase. On average, an approximate 45% reduction is observed as the tiers increase.

The ranges of the emission rates from the three types of vehicles based on the field data was compared with similar estimates from the NONROAD model. These comparisons are summarized in Table 29. The ranges of data shown in Table 29 are influenced by different engine tiers.